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Transformative Outcomes: assessing and reorienting experimentation with transformative innovation policy

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Abstract

The impending climate emergency, the commitments made in the Paris agreement and the UN Agenda 2030 Sustainable Development Goals (SDGs) demand significant transformations in the present economies and societies. Science funders, innovation agencies and scholars have been exploring distinctive new rationales and processes for policy-making, such as transformative innovation policy (TIP). In this paper, we address the question of how to orient the efforts of science, technology and innovation (STI) agencies to enable transformations and address societal challenges. We developed a more consistent and robust approach for assessing the transformative outcomes which may be accomplished through experimental policy engagements. We build on sustainability transitions studies and on a four-year co-creation process carried out by the Transformative Innovation Policy Consortium (TIPC) and present twelve transformative outcomes that can guide the activities of STI agencies in evaluating and reformulating their current or new projects, programmes and policies. We illustrate the transformative outcomes in two empirical cases: transitions towards intelligent transport and mobility-as-a-service in the Finnish mobility system, and the emergence of speciality coffee in Colombia. Our analysis demonstrates that the twelve transformative outcomes can guide STI agents and other change-agents to fundamentally transform their ways of thinking and operation in the course of unlocking transformative change in society.

Keywords:

transformative innovation policy, sustainability transitions, transformation, transformative outcomes, experimentation, policy engagements

1. Introduction

Policymakers working in science, technology and innovation (STI) are facing pressing contemporary challenges such as global environmental change, growing inequality, and now a socio-economic-health crisis in the aftermath of Covid-19. This is most evident in governmental responses to recent global policy agendas, such as the Sustainable Development Goals and the Paris Climate Agreement, in calls for developing ‘green new deals’ and the 2020 World Economic Forum agenda on ‘Fixing inequality’. In each case, reorienting the efforts of science funders and innovation policy professionals is an important aspect of initiating societal change in more sustainable directions.

Across the globe, increasing calls are made for (re)orienting policies towards systemic change, mission-orientation, and societal transformative change. STI agencies in many countries are presently experimenting with ‘challenge-led’ STI policies, which have an expanded scope and target complex and persistent social and ecological challenges instead of just economic growth or support to entrepreneurialism. For instance, the Colombian Department of Science and Technology introduced a ‘Green Book’ in 2018 to provide a roadmap for addressing SDGs by 2030 (Olaya Dávila et al., 2018).

This new wave of STI policies could be labelled as transformative innovation policy (TIP) (Steward, 2012; Weber and Rohracher, 2012; Schot and Steinmueller, 2018; Diercks et al, 2019). This label stems from studies that note a mismatch between traditional innovation policy and the actions needed to address environmental and social sustainability (Edler and Fagerberg, 2017; Boon and Edler, 2018; Borrás and Laatsit, 2019). Steward (2012) observed that early attempts to address these challenges suffered from the persistence of the traditional supply side, production and technology-driven approaches. When addressing societal and ecological problems, STI policymakers remain uncertain about their role vis-a-vis sectoral policies (e.g. energy, transport, food and agriculture, healthcare, water) and other areas implicated in system change (e.g. grassroots innovations). They also struggle to implement challenge- or mission-oriented policies and coordination problems between the growing number of actors implicated in pursuing systemic change.

Weber and Rohracher (2012: p. 1041) called for a new generation of policies to address ‘transformational system failures’ that are ‘preventing processes of transformative change from occurring in a socially and politically desirable way’. They identified four key failures that hinder transformative change: lack of directionality, wrongly directed demand articulation, lack of policy coordination and reflexivity failure. To overcome these failures and confront the mismatch between ambitions, approaches and achievements, Schot and Steinmueller (2018) argued that TIP should be focused on socio-technical system change and be approached experimentally, building on sustainability transitions research, in particular, concepts such as niche, regime and socio-technical landscape as a basis (Rip and Kemp 1998; Geels 2002; Grin et al 2010). At the same time, STI agencies and other change-agents in many countries have been experimenting with novel challenge-led policy programmes, which are beginning to generate results but for which no robust evaluation frameworks

exist (Daniels et al, 2020). Hence, it remains critical to link the emerging theorisations and the practice of TIP to inform the design of novel policy programmes and guide their conduct towards more transformative results.

In this paper, we address the question of **how to orient the efforts of STI agencies to enable transformations and address societal challenges**. Rather than foregrounding the transformational failures, we focus on the transformation dynamics that can be engendered through experimentation, despite those failures. For that, drawing on (Schot et al., 2019; Torrens et al., 2018) we introduce the notion of transformative outcomes (TOs) which encompasses three macro-processes and twelve outcomes that can guide the conduct and evaluation of TIP towards more transformative aims. We further introduce the notion of experimental policy engagements (EPEs), which refers to the various forms of experimental action which can be mobilised for achieving transformative outcomes. These two concepts taken together, can provide a basis for the implementation of TIP by STI agencies, offering an entry point for more reflexive and effective engagements with transformative change¹.

This paper distils the experience gathered in the Transformative Innovation Policy Consortium (TIPC), a five-year transdisciplinary research and action programme² where STI policymakers from a range of countries from the Global North and the Global South worked with a research team to articulate the concept of transformative innovation policy, explore how to use it in practice, and build capabilities around it. TIPC positions itself as a learning platform for co-creating a new generation of approaches that experiment with advancing socio-technical system change and identify new ways of evaluating such experiments. This paper draws from a series of activities aimed at bridging academic and policy knowledge in ways that support intentional and reflexive policy praxis, and respond directly to a demand from TIPC members for approaches to conduct and evaluate their transformation efforts.

We structure this effort as follows. In Section 2, we introduce our co-creation journey and introduce how we conducted the two case-studies from the TIPC programme to refine the application of our approach. Section 3 lays the ground for the transformative outcomes approach, expanding on each of the twelve outcomes. Section 4 presents our two case studies, concerning Mobility-as-a-Service in Finland and the establishment of specialty coffee in Colombia, as reinterpreted through the lens of the new transformative outcome framework. In Section 5, we compare them to draw lessons on how to apply a transformative outcomes framework for TIP. In Section 6, we draw conclusions about the framework and its applicability for achieving system transformations, and outline future possibilities for research and action.

¹ Such change processes are often called a transformation or a transition. Throughout this document, we use the terms transformation and transition interchangeably. Both concepts refer to a system change, although the meaning of a system may differ, from socio-technical to socio-ecological systems.

² Current members are innovation ministries and funding agencies from Colombia, Finland, Norway, South Africa and Sweden. There are additional associate programmes in China, Brazil, Senegal, Ghana, and Kenya. The consortium is coordinated by the Science Policy Research Unit (SPRU) at the University of Sussex, in collaboration with the Centre for Global Challenges at Utrecht University and INGENIO, at Universidad Politécnica de Valencia. See www.tipconsortium.net.

2. Research approach

2.1 TIPC: a co-creation journey

This paper is an outcome of a co-creation journey between a number of STI agencies and researchers working together in the Transformative Innovation Policy Consortium (TIPC). Two features distinguish this journey. First, it is rooted in the shared but context-specific efforts of national innovation agencies and research councils to address societal and ecological challenges, as expressed in the 2009 Lund Declaration and in 2015 UN Agenda 2030 Sustainable Development Goals. Second, the research questions and methods were developed and refined through various transdisciplinary exercises: policy-makers participated in different stages of the research process, while the researchers supported policy-makers in articulating their needs and possible responses. The interpretation of results was jointly refined.

Two of the consortium's key challenges were specifying what was understood as transformative change and identifying what processes may bring it about. These challenges had to be addressed in a wide range of contexts represented by the TIPC membership: Finland, Sweden, Norway, South Africa, Colombia, Mexico (and China as an associated member). The first TIPC pilot years were used to answer these questions. Here, we present an overview of the relevant activities which inspired and shaped this paper.

In its pilot phase (Sep 2016 - Feb 2017), TIPC researchers and policymakers studied supposedly transformative policy activities to clarify the various understandings of what constitutes TIP. They carried out country reviews and pilot cases to elicit indications of transformations and to refine inductively the understanding of TIP. The results confirmed the emergence and proliferation of policies and programmes aimed at inducing transformations in the both Global North and South. These initiatives carried an understanding of a potentially important role for STI policies to address deep systemic problems. However, TIP as a rationale remained mostly marginal, while the mainstream innovation policy was inadequate to address transformations. The science and innovation departments and agencies involved in TIPC recognised that they could contribute more directly to redressing societal challenges, which required more explicit and robust rationales and policy processes. This led to a growing popularity of mission-oriented and transformation-oriented policies (see Mazzucato, 2018; Diercks et al 2019; Schot and Steinmueller, 2019). Nevertheless, TIPC members reported difficulties in integrating these rationales into the practices and instruments at their disposal. It was also difficult to mainstream transformative approaches in their organisations when faced with the legacy of more conventional approaches to innovation policy (e.g. supporting R&D, building Innovation Systems, and stimulating entrepreneurship) (Daniels et al. 2020).

The TIPC pilot phase highlighted practical and conceptual difficulties about 'how to do and evaluate TIP', and motivated the focus on developing a methodology for experimentation and evaluation in the subsequent five-year TIPC action and research programme (late 2017). With this programme, the consortium members sought to enhance their ability to engage in transformation processes. In 2018 and 2019, the research and interaction with members were focused on articulating the concept of experimentation and evaluation. Both streams of work converged around the development of a new

methodology for formative evaluation using transformative outcomes. This article focuses on the latter, while the formative evaluation side is discussed in another paper (Molas-Gallart et al., 2020).

Early on, members and researchers identified experimentation as a critical means for engaging in transformative processes, in accordance with transition theories (see Kemp et al. 1998, Smith and Raven 2012, Sengers et al. 2016). To examine this closely, the TIPC research team conducted an empirical study of different modes of experimentation at play, in interaction with the STI agencies active within TIPC (Schot et al. 2019), and engaged in further conceptual work exploring how attempts to experiment with new policies and approaches actually contributed to the transformation processes at large, beyond the novelty creation and ad hoc experiments with little (policy) impact (see Turnheim et al. 2018). This empirical work on different modes of experimentation and the conceptual work led to the development of the notion of experimental policy engagements (EPEs).

Based on Schot et al. (2019), we define EPEs as *“the diverse ways in which (STI) policy makers engage with processes of societal experimentation for sustainable transformation: initiating, supporting or mobilising, and evaluating such initiatives for informing decision-making, enabling processes of social learning, developing alternative pathways and enacting desirable futures.”*

EPEs differ from how experiments are considered in transitions theory, as primarily centred on creating a novelty and building niches in early stages. EPEs seek to capture the role of different forms of experimentation in the expansion of niches and destabilisation of dominant practices or regimes (Torrens et al., 2018). This insight builds on the recognition that various forms of experimentation are always interventions in a larger transformation process that involve many actors, which almost never is met solely by a policy intervention from an STI agent or other government agencies. Moreover, these engagements often involve a series of such interventions that are frequently time-bounded, which are brought forward in an attempt to steer or navigate an unfolding transformation process. Accordingly, TIPC members agreed that they needed a methodology to help them improve their existing practices and create new ones. This need was translated into the question of how STI projects, programmes and policies, redefined as EPEs, can be made more transformative, and how STI agents can know progress is made in terms of transformation.

Accordingly, in late 2018, the TIPC members decided to focus on developing a formative evaluation method to help orient their new and ongoing projects, programmes and policies on transformative change. The formative evaluation method was chosen to focus on shorter-term outcomes that may lead to broader societal and ecological impacts in the long-term - instead of outputs such as patents, publications - thus allowing an ongoing improvement of those efforts. To support that aim, the concept of transformative outcomes was co-created, and our research began to focus on identifying which were the critical processes implicated in transformations, and defining them for use in a formative evaluation methodology.

We initially drafted the list of outcomes in coordination with other TIPC researchers, drawing on insights from the sustainability transitions literature. That draft list was presented to TIPC partners, discussed and tried out in several workshop settings over several months in 2019 and 2020, such as during the TIPC Learning journey (June 2019), TIPC training week in South Africa (September 2019), TIPC engagement week in Spain (November 2019) and a VINNOVA workshop in Sweden (February 2020). Hands-on exercises with TOs and games (using actor and rule cards) (shown in Figure 1) were used to trial and understand how TO's could be used to improve the design of EPEs, and help the

dissimilar contexts, which helped establish whether the preliminary list of transformative outcomes would be relevant beyond the European context in which transition studies are typically conducted. Second, both cases showed signs of a partial success in enabling a transformation, but in different degrees of maturity. The niche of speciality coffee in Colombia has become a strong market niche while mobility-as-a-service is still a market niche at its early stage of development. Third, the policy engagements in each case showed a stark contrast in how proactive policymakers were. In Colombia, there was little engagement and it happened late in the process, while in Finland it was intense and from an early phase. Finally, for both cases the TIPC team had done extensive data collection, or even had continued to collect data (Finnish case), and the lead investigators could take part in our study.

In hindsight, we approached these cases from what could best be described as abductive inference. As presented by Danermark et al. (2002), abductive inference involves the interpretation, re-description and recontextualisation of individual phenomena within a conceptual framework, which leads to understanding that phenomena in a new way and better appreciation of theory. We argue that abductive case studies are particularly useful in answering our research question: how to orient the efforts of STI agencies to enable transformations and address societal challenges.

Data collection for these cases included workshops, interviews and secondary document analysis, adapted to the nature of each case. In Finland, the first phase (2017) of data collection explored the Finnish mobility transition, including the various emerging innovation niches, and associated policies. An innovation history workshop was organised by two TIPC researchers and nine local experts, and complemented by in-depth interviews with seven experts. The results were published in a TIPC case report (Kanger and Kivimaa, 2017). The second phase (2019), focused on the development of mobility-as-a-service as a potentially transformative niche innovation and examined the role of innovation policy in its development. It included further interviews of seventeen local experts.

In Colombia, the research drew from secondary materials, interviews with representatives of the National Coffee Federation of Colombia (FNC) and a workshop held in the region of Neiva (capital of Huila department) in Colombia on May 13th 2017 with thirty-six stakeholders including grassroots coffee farmers, farmer association leaders, agronomists, representatives of cooperatives and small private companies, and researchers from a think-tank on regional development and coffee present. The results were published in a TIPC case report, co-authored with local experts (Arond et al., 2017).

In re-analysing these cases using our set of transformative outcomes, we sought to highlight not only the points in which our approach appropriately represents the processes of change, but also to bring out ambiguities and tensions as lessons applying transformative outcomes in various EPE contexts. Both cases were revisited for this article with the aim of exploring whether the transformative outcomes can be made visible in the transformation process.

3. Transformative outcomes

The concept of transformative outcomes rests on a specific understanding of dynamics of change in socio-technical systems, which are perceived as complex and adaptive since actors seeking to engender sustainability transitions do so without direct control over the systems in which they act and are part of. A sustainability transition almost never happens in one giant leap or as a result of a specific mission or intervention. Following sustainability transitions theory, change is understood as an

evolutionary and institutional process and is characterised by a myriad of interacting variables that are co-evolving through time and space (Elzen et al. 2004, Grin et al. 2010). In such systems, direct cause-effect relationships are inherently blurry.

In the light of this understanding of system change and following Schot et al, (2019), we argue for a shift away from specific one-off interventions or policy missions, towards a more systemic and continuous governance approach that incorporates experimental policy engagements as directional and reflexive pursuits of sustainability transformation. On the one hand, these engagements may be used to overcome transformational failures identified by Weber and Rohracher (2012): they enable reflexive thinking, induce directionality, improve policy coordination and lead to demand articulation. On the other, they may mobilise a constituency for change despite those failures. The assumption is that, if actors work towards transformative outcomes, they increase the chances of a sustainability transitions.

Below we define twelve transformative outcomes which actors can have influence over. Four assumptions informed by transition theory ground their definition: First **transformations require changes in the rule-sets that underpin the configuration of socio-technical systems, in multiple dimensions**. We distinguish five dimensions: 1) technology (products, processes, infrastructures), 2) the demand structure (user preferences), 3) the industry strategy and structure, 4) the policy and politics that sustain the systems and 5) meanings and symbols that make the system culturally attractive. At a deeper level, system change unfolds by changing the various types of rules that are expressed or embedded in the different system dimensions (Grin et al., 2010; Ghosh and Schot, 2019). Rules can be understood in a sociological sense as institutions that constrain and enable actors, and in an evolutionary sense as the genotype (retention structure) of systems. Building on Scott (1995), different types of rules can be distinguished: behavioural or regulative rules (standards, protocols, instructions how to behave), cognitive rules (beliefs) and normative rules (values and norms). When rules are combined in rule-sets covering various system dimensions, they form a socio-technical regime. Transformative outcomes refer to changes, not only on the level of system properties, but also at the level of rules.

Second, **the dynamics of system change can be understood by analysing the complex interactions between niches, regimes and the landscape, as conceptualised in the Multi-level Perspective (MLP)**. According to this perspective, transformations of systems and regimes require the creation and expansion of alternatives (niches), and processes that open up and unlock regimes for change. All these processes and their interactions are influenced by a collection of trends and shocks (the climate crisis, increasing inequality, pandemics such as COVID-19; digitalisation) called the socio-technical landscape. Such transformations can follow very distinct pathways of change depending on the stability of regimes, availability and maturity of niche alternatives and on how trends and shocks influence the niche-regime interactions. (Smith et al., 2005; Geels and Schot, 2007).

Third, **transformations involve multiple actors with incongruent interests and are therefore deeply political processes, riddled with choices and conflicts**. In the MLP, actors shape transitions. The ways in which the transitions unfold and the directions they take depend on how actors interact. Having a diversity of actors involved in the transformation process will generate more innovation and more radical transformation, and will enhance the participatory democratic quality of the process. In our conceptualisation of transformative outcomes, we look at actors in three ways. First, we make a crucial

distinction between niche and regime actors, and assume that niche actors are key for unlocking regimes. Niche actors can be seen as newcomers who are less constrained by the rules of the incumbent regimes, i.e. dominant prevailing practice. Second, niche and regime actors are distributed across the system dimensions and, since all dimensions need to change, it is important to have a diversity of regime and niche actors (governments, business, users, experts, and civil society) involved. Third, since transitions are about putting sustainability at the heart of the innovation process, they need to involve people who will be most adversely impacted by this transition. This means including, not only people who know how to get their voices heard, but also marginalised groups who need to have a say in a fundamental change of lifestyles, how we live, work, eat, treat patients, use energy and other resources. This is, in the end, what a transformation entails.

Fourth, **transformative outcomes unfold not only over time, but also spatially**. Here, the literature on the geography of transitions is most relevant (Dignum et al; Binz et al, 2020). Spatial differences and place-based conditions play a crucial role in enabling or disabling transformational processes (Hansen and Coenen, 2015). Experimentation is particularly important to probe and address context-specific institutional conditions and to examine and demonstrate the applicability of innovations in a variety of socio-spatial contexts. In our definition of transformative outcomes, we seek to incorporate a spatial dimension, recognising that experimental policy engagements are rarely confined to local contexts, but rather encompass activities, actors and resources scattered over distinct scales and geographies. For instance, transformations are enabled through establishing supportive networks that span, beyond the local, to regional, national and international settings, or by mobilising experiences from a multitude of locations to enrich or justify 'local' experiments (Avelino et al, 2019; Wieczorek et al., 2015). EPEs often provide practical opportunities for the emergence of coordination across geographies connecting, for example, local niches and regimes to global ones (Fuenfschilling and Binz, 2018).

Based on these four assumptions, we propose three general spatially-bounded macro processes that can facilitate transformations: 1) building and nurturing niches, 2) expanding and mainstreaming niches and 3) opening up and unlocking regimes. We do not assume they follow a specific sequence, they can run in parallel, except for the process of expanding and embedding which assumes processes of niche building to have occurred. Expansion processes may however begin before the niche building process is completed.

To provide more granularity to our analysis, we identify in each of the three macro-processes a set of four sub-processes which are implicated in and can help in systematically understanding the unfolding of transformations, and label the resulting twelve sub-processes transformative outcomes (TOs). These are processes in which new system dimensions and their underlying rules emerge and old rules embedded in specific system dimensions are questioned and replaced. Through change in rules, TOs mark changes in socio-technical practices towards more transformative ones. With this set of transformative outcomes, we advance the understanding of specific processes that policymakers might want to target, in order to activate and accelerate the niche and regime level macro processes that will influence systemic transformations.

The following sections detail the twelve transformative outcomes and exemplify their applicability, providing sufficient granularity for evaluative and reflexive processes as developed in TIPC.

3.2 Building and nurturing niches

Niches (illustrated as a closed sphere in Figure 2) are especially valuable for transformations because they provide spaces for building alternative practices from which new rules and systems can emerge. They are seedbeds, harbours and battlegrounds for transformation (Torrens et al., 2019). The conceptualisation of this process is based on strategic niche management theory (Kemp et al 1998; Raven et al, 2010). Within the process of building and nurturing niches, four transformative outcomes are identified: a) shielding, b) learning, c) networking, and d) navigating expectations. For each of these outcomes we introduce a distinction between broadening and deepening. The former relates to expanding the scope, while the latter focuses on improving the quality and directionality of the process (Schot and Steinmueller, 2018).

3.2.1 Shielding

Shielding comprises specific interventions by policymakers and other actors who deliberately create positive conditions for niche innovations. For example, through R&D or deployment subsidies, preferential tax treatment, public or collective purchasing, voluntary agreements, regulation, and/or information campaigns (Raven et al., 2010). This is what (Smith and Raven, 2012) refer to as active shielding which is often necessary to create a space for niches to develop. However, niches may also exist without active shielding measures. Specific actors may be willing to engage in alternative practices because of their own preferences or because of specific geographical conditions. Active and passive shielding can, and often do go together in the niche construction process, but in the end it is important that the balance moves from active to passive, and that shielding becomes embedded in routine actor behaviour.

As a transformative outcome, we propose *broadening of shielding* by increasing the diversity of shielding strategies to cover the multiple system dimensions like policy, market incentives, scientific knowledge, user preferences and cultural meaning (Ghosh and Schot, 2019). With broadening of shielding, we expect that more diverse and more systemic alternatives are able to flourish in niches. Alongside broadening, *deepening of shielding* is also important by finding ways to phase out active shielding measures in such a way that shielding becomes passive, for example, that new rules (new behaviours, new beliefs and values) for all system dimensions become the preferred behaviour of all niche actors. In other words, passive shielding refers to a scenario where actors do not engage with the niche because of specific incentives, but because they believe that niche activities are the right way to go. Shielding strategies are sensitive to geographical, socio-economic and cultural contexts (Smith and Ravens, 2012). Therefore, considering how to broaden and deepen shielding of the niche in and beyond a specific context is important for facilitating transformative change at a local, regional or national level.

3.2.2 Learning

Strategic niche management theorists suggest that niches are strategic locations for reflexive learning processes (Schot and Geels, 2008; Raven et al., 2010; Naber et al, 2017). According to this literature, there are at least two types of learning: first order and second order learning (also known as single loop or double loop learning) (Pellicer-Sifres et al, 2018; Smith and Raven, 2012; Van de Kerkhof and Wieczorek, 2005). While first order learning is about information gathering and knowledge

accumulation in order to solve policy problems in a specific context, ‘second order learning’ is about thinking through the problem itself and challenging assumptions and perceptions of “problem solving, problem definition, dominant interpretative frame and worldview” (Sengers et al, 2019: 157; van Mierlo et al, 2020). While both first and second order learning are important for system change, the latter as ‘higher order learning’, is often associated with ‘learning-by-doing’ and is deemed more ‘transformative because it challenges the underlying rules of the dominant regime’ (Poeck et al, 2018; Loorbach et al, 2011; Mezirow, 2000).

As a transformative outcome, we put emphasis on both first order and second order learning. Broadening of learning means facilitating first and second order learning in more than one system dimension. This will inevitably require the accumulation of knowledge and questioning assumptions among multiple actors from multiple disciplines (e.g. engineers looking beyond technical knowledge), and a change from finding technical solutions to investing in collective problem-solving capacity (Poeck et al, 2018). Alongside broadening of learning across actors and system dimensions, it is also important to *deepen* learning. *Deepening of learning* equals second order learning. This type of learning is a cognitive change in which the web of facts and understandings is re-configured in a new pattern. It focuses on challenging the existing rules and specifying new rules (behaviours, beliefs, values). Such deep learning requires a holistic and context-specific understanding of the sustainability problems faced by the socio-technical systems (Raven et al, 2017). Deep second-order learning as a transformative outcome also enhances reflexivity, trust and retention of new rules among actors and enables translation of the learnings from niche building process into more generalisable forms (Turnheim et al., 2018; Safarzyńska et al., 2012, Borghei and Magnusson, 2018; Sol et al., 2017; van Mierlo et al, 2020). For broad and deep learning to occur, the type and quality of actor-networks is a key factor, which is our next transformative outcome.

3.2.3 Networking

Networking between a diverse set of actors is the third transformative outcome in niche building processes and involves broadening and deepening activities. As niches are built, new social networks emerge between actors from diverse backgrounds, knowledge and skills (Smith and Raven, 2012). *Broadening of networking* between actors implies inclusion of actors operating both in the context of niches and regimes, across various system dimensions (such as government, business, civil society, and knowledge institutions), as well as different sections of the society (elites and more marginal groups). Such broadening of the networking process raises transformative potential, because engaging a plurality of perspectives reduces the risk of social exclusion, discrimination and lock-in to a single transition trajectory. However, broad networking might lead to tensions and conflicts among actors or be dominated by regime actors in the niche. In the latter case, the type of change is then likely to be ‘fit and conform’ type of change (Smith and Raven, 2012). A deepening of the networking process might help mitigate this conformity and facilitate more transformative change. *Deepening of networking* means more and better coordinated mobilisation within and between communities of actors. Deepening then implies improving the quality of networks through developing mutual trust and commitments among actors bringing in more resources in order to support the niche (Schot and Geels, 2008; Naber et al., 2017; Sol et al, 2018). A new set of actors called “niche intermediaries” are useful in enhancing the power of such mobilisation (Kivimaa et al., 2019). Niche intermediaries can consolidate and aggregate multiple niche experiments and strengthen the ‘common voice’ of the niche

(Smith et al., 2016). Broadening and deepening of networking contributes to new expectation dynamics within the niche, which is our fourth transformative outcome.

3.2.4 Navigating expectations

The fourth transformative outcome in niche developments is the voicing and exchange of expectations about its future potential. These expectations can refer to future trends and shocks at the landscape level, the ability of regimes to respond, and the problem and market solving potential of niche innovations (Truffer et al 2008). Expectation dynamics can be volatile and develop with hype and disappointment cycles (Konrad et al., 2012; Verbong et al., 2008). They may vary across niche and regime actors as well as across socio-political and cultural contexts (Budde et al, 2012; Coenen et al., 2010; Brown and Michael, 2003). As a result, niche actors are required to *navigate* a 'sea of expectations' and the ambiguity it generates, before they may find some convergence into shared visions, eventually guiding niche development (van Lente, 2012; Raven et al, 2010; Borup et al., 2006). Navigating expectations refers to a process in which a diversity of expectations is made explicit and then negotiated, leading to a more robust understanding of shared expectations across niche and regime actors investing in the niche (Konrad 2006).

Articulation of expectations is an important process in strategic niche management (Smith and Raven, 2012; Raven et al., 2010; Schot and Geels, 2008). Drawing from that tradition, we define broadening as seeking to accommodate a range of expectations about landscape developments, the future ability of regimes to respond, and niche performance (Truffer et al, 2008; Budde and Konrad, 2019). Broadening of expectations is an accommodation process inevitably involves acknowledging tensions and conflicts of interests in multiple articulated (and unarticulated) expectations (Delina and Janetos, 2018; Jørgensen, 2012; Borup et al., 2006). Simultaneously, it is important to deepen expectations by finding alignment strategies that knit together multiple expectations across landscape, regime and niches levels in ways that support their convergence (Truffer et al 2008; Budde & Konrad, 2019). The quality, stability and credibility of expectations can be improved by developing evidence underlying each of the articulated expectation. Together, broad and deep expectations help navigating hype cycles, contested visions, and increase chances of transformative change by opening up possibilities of multiple sustainable futures.

Navigating expectation dynamics are closely interlinked with shielding, learning and networking processes. EPEs can and should strive to achieve more than one transformative outcome within a transformative change process. Achieving multiple transformative outcomes in niche building also means more potential for the EPE to contribute towards expanding and mainstreaming the niche, which is to be elaborated next.

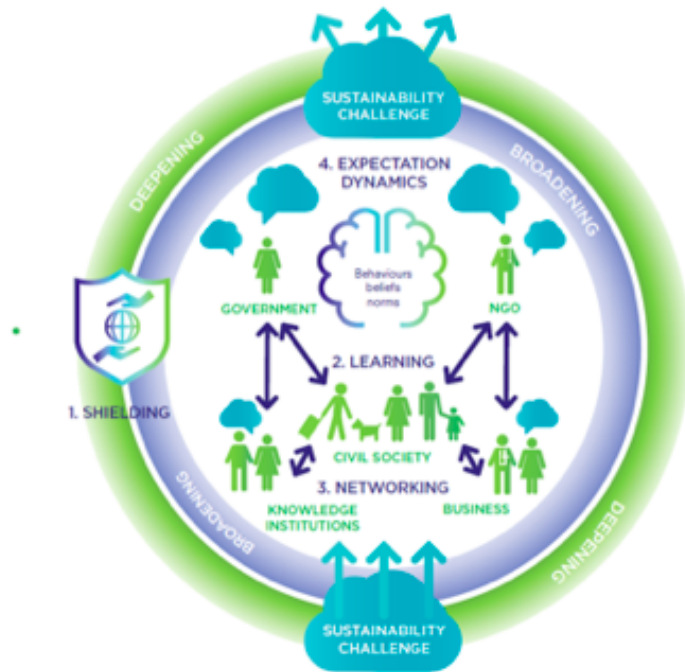


Figure 2. Transformative outcomes in niche building and nurturing process

3.3 Expanding and mainstreaming niches

For transitions to happen, niches need to expand in scope and scale. The expansion process of the niche implies that the rules and practises emerging in the niche are ‘mainstreaming’ (Gibbs and O’Neill, 2015). Mainstreaming is a level of acceptance and credibility for the niche that assists in its take up or adaptation in contexts outside of its immediate origin. Four transformative outcomes can be discerned from the existing literature on niche acceleration and embedding (Naber et al., 2017; Turnheim et al., 2018; Meelen 2018). Below, we introduce the outcomes; namely a) upscaling, b) replicating, c) circulating and d) institutionalising. The latter three all contribute to upscaling, while they are distinct processes that can be shaped by EPEs separately from focusing on upscaling as such. Figure 3 illustrates these outcomes with ‘time’ in the horizontal axis and ‘stability of rules’ in the vertical axis.

3.3.1 Upscaling

Upscaling concerns the increase in user adoption and diffusion, where a technology (or a social innovation) when scaled up implies bigger units and broader market infiltration (Turnheim et al., 2018). It equals the bandwagon effect in the technology diffusion process (Verbong and Geels, 2007), except this is not a process of product or process diffusion but system diffusion (Geels and Johnson, 2018). It means that users not only adopt the new technology (or social innovation), but also develop new user preferences. This process is assisted by the development of new policy measures, industry strategies and cultural meanings focusing on user adoption (Seyfang et al., 2014; Jolly et al., 2012). In a recent study on solar development in China, Yang et al., (2020) argue that, for technologies that induce system innovation, the bandwagon threshold may be reached when 16 percent of the potential market adopt a new niche practice, including its technology. At this threshold, new users adopt the

practice, not so much because of the specific niche conditions, but because they accept the new rules embedded in the technology as a (future) mainstream option.

3.3.2 Replicating

Replicating refers to the geographical expansion of the niche, by recreating a similar niche space in new socio-spatial and cultural contexts (Bos and Brown, 2012; Turnheim et al., 2018). This may also lead to upscaling, yet the focus is different. Unlike upscaled niches, replicated niches are geographically disconnected from one another and have their own shielding, learning and networking strategies. For transformation at the urban level, for instance, it has been argued that niche expansion can happen through a process of replicating multiple small-scale experiments (Raven et al., 2019).

A key consideration for replicating niches is that new niches need to be place-based and specific to the socio-institutional, political and cultural conditions in each context (Raven et al, 2012; Coenen et al, 2012; Hansen and Coenen 2015). This anchoring process in a new context requires the accumulation of learning and knowledge flow across contexts (Carvalho and Lazzerini, 2018; Seyfang et al., 2014). Niches need to be decontextualized from their source, meaning that they need to be sufficiently generalised from a particular context, before being re-contextualised in the new context. Seyfang et al. (2014: 23) elaborates on this process in three steps: “(i) consolidate the learning flowing ‘up’ from projects, (ii) repackage it into mobile forms as transferrable standards, best practice and other resources to help new projects, (and iii) re-interpret and embed the knowledge ‘downwards’ into new local contexts.” Feola and Nunes (2014) show that the success or failure of replicated niche initiatives depend on the considerable awareness and estimation of contextual factors where the niche is being replicated. Depending on the success of this contextualisation and re-contextualisation, a replicated niche may be more transformative than the original niche.

The process of replication is often facilitated by intermediary actors such as international organisations or donors, who are able to share knowledge and resources across localities and help in creating a global niche (Geels and Dueten, 2006; Hansen and Nygaard, 2013). However, Seyfang et al (2014) show that it may be challenging for intermediaries to ‘pull out’ the niche from its original context, before being transferred to the new context. Simultaneously, global intermediary actors are not the only ones enabling the replication of niches. Replication of niches may also happen via the initiatives of local actors aimed at imitating successful niches from elsewhere. The example of successful replication of the Transition Towns niche in multiple countries suggests that similar niches may emerge at different places in response to shared visions and perceptions of landscape pressure, such as the need to shift to a low carbon society (Seyfang and Haxeltine, 2012).

It is often challenging to replicate niches in their entirety in another city or place. This brings us to the next transformative outcome: the circulating of important elements of a niche, instead of the niche in itself.

3.3.3 Circulating

Instead of the whole niche being replicated elsewhere, niche expansion and mainstreaming can happen through ideas, people, rules, products, texts and learning circulating between different niches. In this regard, circulation is a process that is more fluid and dynamic enabling a variety of ways in which

multiple niches from different spatial and cultural contexts may connect - leading to the overall expansion of the global niche (Geels and Deuten, 2006).

Circulation between niches is often ad-hoc and limited, since actors are too focused on developing their own niche. Therefore, an important role can be played by dedicated niche intermediaries or 'champions' in the circulation of learning, through transferring learning from multiple local projects or experiments to the niche space (Martiskainen and Kivimaa, 2018). They may ensure that circulation is more continuous, is comprehensive covering many aspects of the niche development, and is an interactive process facilitating an exchange of ideas and rules across niches and even between niches and regimes (Kivimaa et al., 2019; Bush et al., 2017).

3.3.4 Institutionalising

The final transformative outcome in the niche expansion and mainstreaming process is institutionalising niche innovations. This is primarily achieved through developing stable shared rules, behaviours, beliefs and values, carried by an expanded niche. In other words, the niche is on its way to become a regime (Fuenfschilling and Truffer, 2016; Geels and Deuten, 2006). Institutions or regimes are building-blocks of social order that integrate collective expectations from the behaviours of individual actors or the enactment of individual activities, including rights and obligations for actors (Streeck and Thelen, 2005). Thus, institutionalisation is a crucial transformative outcome in the process of niche mainstreaming, ensuring that the rules emerging from a single niche or multiple connected niches are collectively adopted, becoming mainstream.

An important aspect of institutionalisation is to build consensus from multiple contested visions and perspectives into convergent definitions, standards and preferred types of behaviours and interpretations. This is a challenging and delicate process, since it threatens the diversity and inclusivity features associated with the niche building process. An effective way to address this challenge is by establishing a community of practice (Wenger, 2002) that would socialise newcomers on a regular basis into the new regime.

Earlier studies have shown that intermediaries help in empowering niches (Bush et al., 2017). Especially, 'institutional entrepreneurs' or 'institutional actors' who focus on creating and maintaining shared rules, open up prevailing regimes for change and build up a constituency behind the new regime (Lawrence and Suddaby, 2006; Fuenfschilling and Truffer, 2016; Battilana et al, 2009: 67; Pelzer et al, 2019).

EPEs focused on expanding and mainstreaming the niche are often resisted by regime actors. The latter need to become convinced a change is needed. Therefore, for facilitating transformational change, a third and final transformative process is necessary. This is at the regime level and includes the final four transformative outcomes.

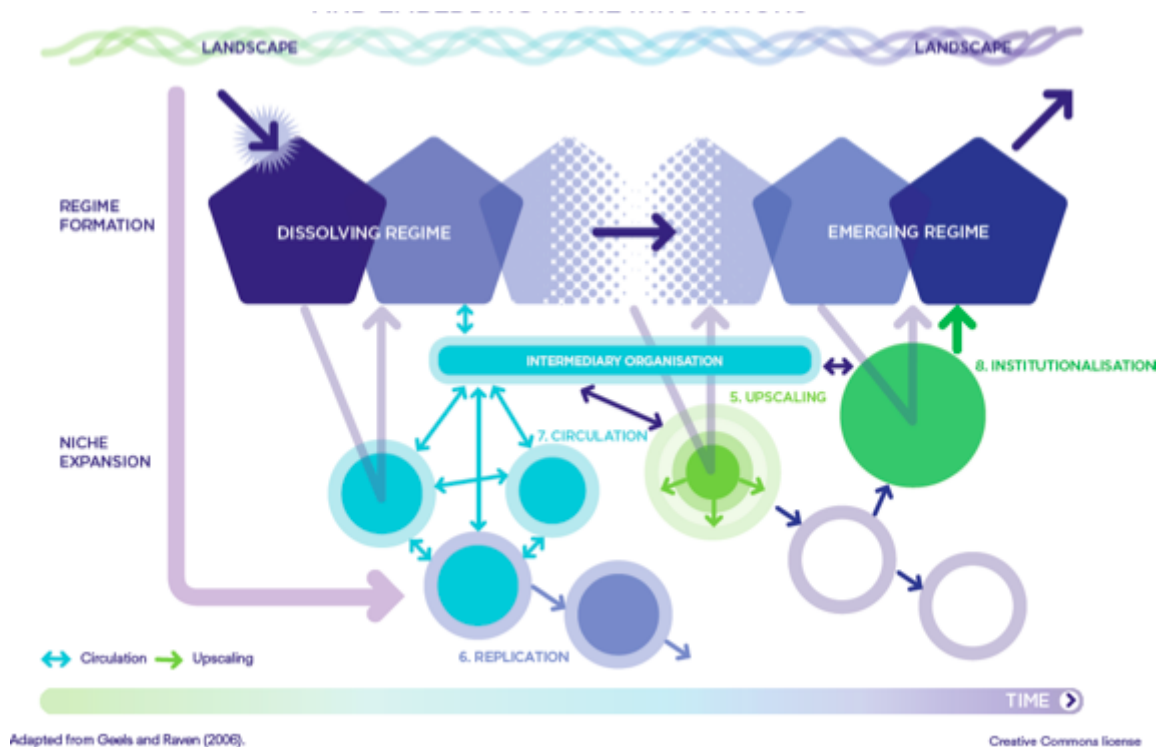


Figure 3 Transformative outcomes in the niche expansion and mainstreaming process (adapted from Naber et al, 2017)

3.4 Opening up and unlocking regimes

While the two previous transformative processes are well researched in the transitions literature, theories and cases on opening up and unlocking regimes are less prevalent. Openings in the regime provide niche innovations with ‘windows of opportunity’ to challenge the current regime and claim more space for alternative practices and system configurations (Geels and Schot, 2007). The process of unlocking relates to the important idea of rigidity of stabilised solution supported by regime actors, causing incrementalism in existing trajectories (Geels, 2005; Verbong and Geels, 2010; Mercure et al., 2016). This means that when socio-technical regimes are optimised, they tend to follow a particular path (Ghosh and Schot, 2019). Even when alternatives are proposed by regime actors, they tend to reaffirm the architecture of the system as it is, for example, proposals to decarbonise energy production via carbon capture and storage technologies or new business models, instead of radically new alternatives such as switching fuels, increasing low-carbon energy production, reduced energy consumption and improving energy justice (Sovacool et al., 2020; Martiskainen et al., 2018; Gaede and Meadowcroft, 2016; Geels et al, 2016). Rigidities in incumbent regimes become problematic when they hinder transitions towards sustainability and/or fail to respond to the dynamic and persistent societal challenges. With regard to sustainability, the consequences of such lock-in in a certain path can be catastrophic.

Some studies have highlighted the importance of destabilizing unsustainable regimes as a critical process for replacing optimising regimes (Turnheim and Geels, 2012, 2013; Kivimaa and Kern, 2016; Roberts, 2017; Ghosh and Schot, 2019). However, some transition pathways, such as reconfiguration or realignment pathways, highlight other mechanisms of change which do not necessarily require

complete destabilisation and displacement of existing regimes (Geels and Schot, 2007). In describing the transformative outcomes for opening up and unlocking regimes, we explore multiple ways in which transformative change can be facilitated at the regime level. The four transformative outcomes within the regime level transformative process are: a) de-aligning and destabilising, b) unlearning and deep learning, c) strengthening regime-niche interactions and d) changing perceptions of landscape pressures.

Figure 4 depicts these outcomes within the pentagon that represents the socio-technical regime boundary. The five corners represent the five dimensions of a regime (Ghosh and Schot, 2019). The partly visible pentagons behind the purple one suggests the presence of multiple socio-technical regimes that co-constitute societies. While our earlier discussion on niche building and nurturing and niche expansion and mainstreaming did not consider multi-regime (and niche) dynamics, for this last set of transformative outcomes we consider more explicitly these interlinkages.

3.4.1 De-aligning and destabilising regimes

Regime destabilisation is defined as the reduction of alignment between system dimensions, resulting in a process in which regime actors abandon behaviours, beliefs and values constituting the regime. Such destabilisation has been described as weakening reproduction of and flow of resources to core regime elements (Turnheim and Geels, 2012). An introduction and implementation of a new policy (Kivimaa and Kern, 2016) or a new industry strategy (Karlton and Sanden, 2012), by one of the main regime actors, that challenges the existing regime may result in such a dealignment. One specific challenge for de-aligning system dimensions can be a strong interconnection between two or more regimes. For example, the car-dependent mobility system in the United States was deeply intertwined and coupled with the housing system, in particular the nature of urbanisation and affordable housing in the suburbs. Strong couplings within and between regimes are sources of stability and obduracy, which is often achieved over long periods of co-evolution between socio-technical systems (Konrad et al., 2008). De-aligning and destabilising those alignments can be very difficult due to existing path-dependencies. They can be partly tackled with unlearning which is the next transformative outcome.

3.4.2 Unlearning and deep learning in regimes

In locked-in regimes, individual actors become entrapped in the system's dynamics (Sydow et al., 2009), as they prioritise conformity of their beliefs and assumptions. They strongly believe in the viability of their regimes for confronting problems and in its legitimacy among wider populations (Geels, 2010). Regimes are stabilised through the conformation of the behaviours, beliefs and values of regime-actors across multiple dimensions. Simultaneously, regime stability results in dominant rules that allow actors to respond to existing market conditions in a cost-effective way. Under these circumstances, a crucial aspect of opening up regimes is unlearning and deep learning among regime actors.

Van Mierlo and Beers (2018: p.261, 264) define unlearning as abandoning obsolete practises and leaving behind old ineffective habits. Thus, this outcome implies that regime actors begin to question their behaviours, practices, beliefs, and values that are embedded in their existing skills and capabilities. Unlearning includes an acceptance of risks and uncertainty, and the costs of the reorganisation of the regime in short to medium term. This process of unlearning is coupled with deep

learning about new behaviours, practices and values. Strengthening regime-niche interactions, the next transformative outcomes, is a way to create stimulus for deep learning.

3.4.3 Strengthening regime-niche interactions

The opening up and unlocking of the regime is incomplete without the regime(s) interacting with niche(s). In MLP terms, this mechanism includes vertical interaction (between niches and regimes) and horizontal interaction (between regimes). The importance of interaction between regimes and niches, and their co-evolution has been acknowledged in the sustainability transitions literature (Raven and Verbong, 2007; Konrad et al., 2008; Sutherland et al, 2015).

Strengthening regime-niche interaction may involve many strategies and mechanisms such as niche empowerment, intermediation by regime actors, and opening up of interconnected regimes to facilitate a dynamic and reflexive process of niche-regime linkage (Ingram, 2015). This transformative outcome focuses on ways in which regime actors try to reach out to multiple niche actors who challenge them with the aim to support niches to become more competitive. It involves considerable change within the regimes, for creating new actor-networks that comprise both niche and regime actors. This building of connections can go into two directions. It can seek to support niches to integrate them into the prevailing regime. This is a 'fit and conform' type of niche empowerment. On the other hand, regime and niche actors can also mutually support each other for changing the selection environments in favour of path-breaking niche innovations that may threaten the future existence of the regime. This is known as a "stretch and transform" type of niche empowerment (Smith and Raven, 2012).

The dynamics of strengthening interaction is also influenced by the interconnected nature of regimes, constituting society (Pekkarinen and Melkas, 2019; Sutherland et al., 2015; Slingerland and Schut, 2014). Sutherland et al., (2015: 1551) finds that opening up multiple regimes will empower niche development.

Intermediaries, particularly regime-affiliated and systemic intermediaries, play a role in mitigating these tensions and in steering fruitful interactions between niche and regime actors by "brokering and coordinating partnerships beyond the niche" (Bush et al., 2017: 139; Kivimaa, 2014; Kivimaa et al., 2019). They can also help in linking newly emerging socio-technical narratives among niches to the socio-political agendas set by regime actors. These intermediaries, despite their regime-based mandates, are influential in building strong and long-lasting relationships between niches and regimes. Such strong regime-niche connections are also helpful for incumbent actors to comprehend and act towards bigger and deeper systemic issues which we discuss in the next section.

3.4.4 Changing perceptions of landscape pressures

In the MLP, the landscape is typically considered to comprise of macro-level, exogenous, long term and slow-moving trends, such as climate change, or rapid external shocks, like Covid-19, which the niche and the regime may not seem to be directly influencing (Van Driel and Schot, 2005; Geels, 2011). Despite their exogenous nature, the landscape pressures considerably influence how, in which direction, and with what speed systemic transformations may unfold because of their stabilising and/or destabilising power on the regimes and niches (Geels, 2011). Regime actors are known to react in different ways to 'landscape inertia' (trends, opportunities and threats), depending on their political

ideology, cultural understandings, societal preferences and lifestyle (Li and Strachan, 2017; Simpson, 2019).

The ways in which landscape pressures are perceived by regime actors is uneven and varies across contexts (Hansen and Coenen, 2015). It is also important to realise that the landscape consists of many trends, and not all are converging. When regime actors begin to see alignments between multiple external pressures, it could create an ‘overwhelming effect’, leading to altered perceptions (Turnheim and Geels, 2012). Thus, this transformative outcome emphasises how regime actors could become more receptive to the kinds of landscape pressures they detect and deem important.

This conceptualisation rests on the idea that the potential for opening up and unlocking regimes under landscape pressure is strongly influenced by how regime actors perceive them, and how this subsequently affects decision making, redistribution of resources and commitments to enable system change.

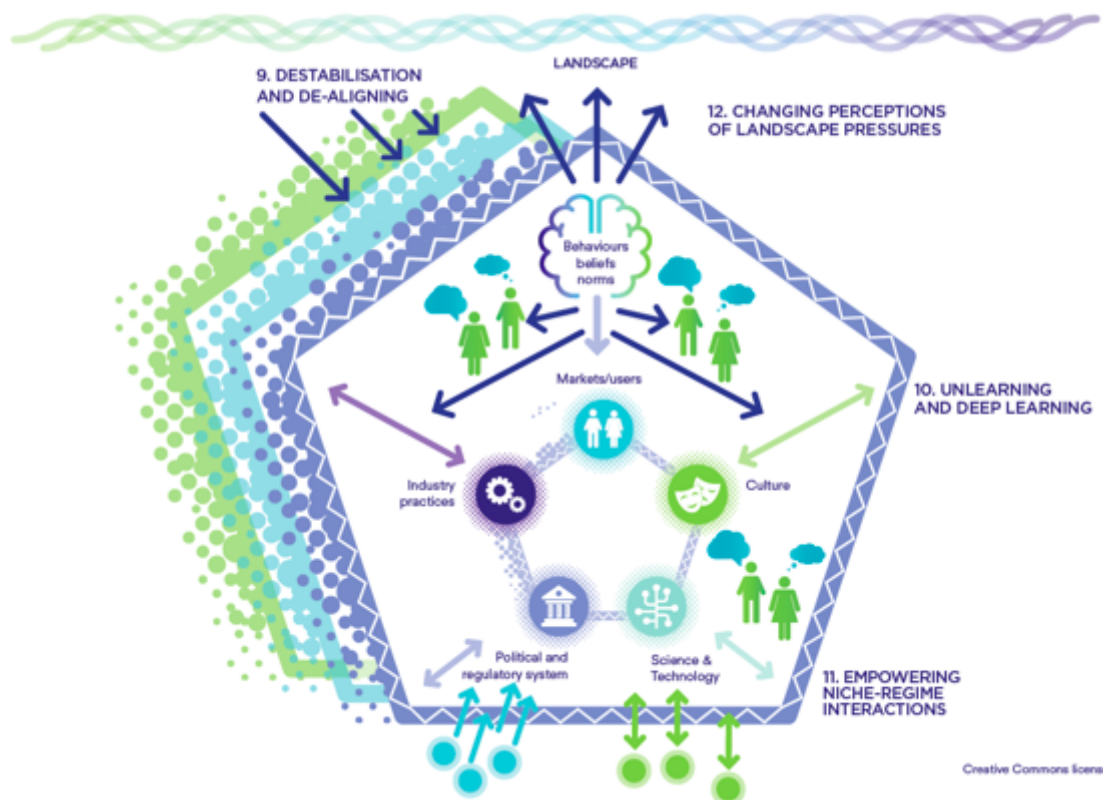


Figure 4. Transformative outcomes in the opening up and unlocking regime process

3.5 Experimental policy engagements with transformative outcomes

In this paper, we have treated transformative innovation policy as an exploratory concept, acknowledging that design, implementation and evaluation of TIP requires further experience and reflection. We explore the idea that STI policy makers should focus on making unfolding transition

dynamics more transformative by focusing their project, programmes and policies on transformative outcomes. The promise is that this compass of transformative outcomes may not only help them overcome transformational failures (lack of directionality, wrongly directed demand articulation, lack of policy coordination and reflexivity), but also provides an avenue for engaging more positively with the transformation. It is clear that this engagement begins with a very ambitious and clear mission of addressing the SDGs, and is rooted in a second and similarly ambitious idea that STI agents should focus their activities on socio-technical system change. In brief, addressing the SDGs (or missions derived from it) requires STI agents to focus on transformation (Schot and Steinmueller 2018; Ramirez et al, 2019). This is a very ambitious goal.

It is ambitious because, after all, transformation processes are complex and long term. They also have a need for many types of knowledge, and innovation inputs spread over various stages of the process. These demands are difficult for STI policy activities that consist of a host of relatively short term, insufficiently coordinated projects. But above all transformation processes do not only concern science and technology, they also need shaping of new markets, a change of industrial strategies and structures, new forms of governance and policy making across the government, and finally a change of culture. STI agents are only one actor among many, and are not used to combine social and technological components.

To realise ambitious SDGs, with relatively humble means and capacities, we have, therefore, advocated the notion of EPEs as developed within the TIPC. This notion puts emphasis on the fact that STI agents are not in a position to design or control a transformation process, but they can engage with it and modulate its development. They can look at all their projects, programmes and policies and ask the question whether and how they contribute to the transformative outcomes. EPEs also stress the experimental nature of this engagement which means that it is temporary and should add a reflexive layer to the ongoing transformation process. The focus should be on mobilising and helping a wide range of actors to find out how they can contribute. In this process, EPEs provide spaces for deliberation about the desirability of particular pathways that promise a more sustainable future, and for conflicts and tensions to emerge and be resolved, if possible.

We are not suggesting that STI agents are the only ones working on transformative outcomes. On the contrary, ongoing transformations will already produce such outcomes; yet, STI agents through their own activities can stretch what is ongoing and put into place what is not yet happening. They may also have to engage in new types of activities. STI agents should ensure that their various projects, programmes and policies contribute to the building up and nurturing of niches, the expansion and mainstreaming of niches and opening up and unlocking of regimes. Table 1 summarises the transformative outcomes and provides examples of possible EPEs; some of which may be out of reach for STI agents. They will need coordination with other policy actors.

Table 1: how do experimental policy engagements (EPEs) contribute to achieving transformative outcomes (TOs)

| Macro-process | Transformative Outcome | EPEs contribution |
|----------------------------------|------------------------|---|
| 1. Building and nurturing niches | 1.1. Shielding | <p>Offering protection for niche experiments and normalizing these protection measures.</p> <p><i>Broadening:</i> identifying, testing and developing strategies to protect niches covering multiple system dimensions, encompassing a wide range of experiments and more diverse alternatives.</p> <p>For example, providing subsidies for innovation projects (STI dimension), parking benefits to electric vehicles (market dimension), or media campaigns to promote organic food (cultural dimension).</p> <p><i>Deepening:</i> institutionalising active shielding mechanisms (across all experiments), and making them more permanent in order for the niche to flourish without specific temporary measures put in place.</p> <p>For example, providing a permanent VAT exemption for organic food, integrating organic food consumption into standards for food provision in schools, making specific (parts of) cities only accessible for electric vehicles.</p> |
| | 1.2 Learning | <p>Induce first and second order learning in niche experiments. First order learning has a focus improving what actors are doing while second order learning questions frames and assumptions of structures and activities of actors.</p> <p><i>Broadening:</i> including more dimensions of the system in the first and second order learning process and incorporating different forms of knowledge (e.g. beyond technical knowledge from a single discipline), involving multiple actors (diversity and trust) and aspects of sustainability.</p> <p>For example, not only focus on how to develop solar technology but also address opportunities and barriers for viable business models, and consumer behaviour integrating various knowledge aspects and actors in the learning process.</p> <p><i>Deepening:</i> creating opportunities for challenging assumptions (about preferred solutions, problem definitions and whether and how they contribute to sustainability).</p> <p>For example, doing a study with multiple actors about the question whether and how biofuels contribute to the SDGs; organising a workshop with diversity of actors about question whether electric vehicles are just a solution for the rich, and whether and how they will reduce car mobility substantially.</p> |
| | 1.3 Networking | Create high quality opportunities for collaboration between actors, strengthening their networks. |

| | | |
|---------------------------------------|-----------------------------|--|
| | | <p><i>Broadening</i>: convening joint activities with enough flexibility around which multiple actors can congregate and mobilise, acknowledging diverse beliefs, values and concerns.</p> <p>For example, including a diverse set of patients, civil society actors, food shops, fitness centres, and schools next to health care professionals, policy makers and insurance companies in an experiment with a new way of local healthcare provision that integrates healthcare with life style.</p> <p><i>Deepening</i>: enhancing the mobilising power, mutual trust and coordination among the actors involved in the niche ensuring the stability of actors-networks over a longer period of time.</p> <p>For example, establishing intermediary niche actors that build platforms for more permanent interaction among various actors.</p> |
| | 1.4 Navigating expectations | <p>Create a space for voicing and articulating expectations around societal challenges and appraising these expectations in order to enhance their credibility (among niche actors), quality (providing more evidence) and stability (expectations are not questioned anymore).</p> <p><i>Broadening</i>: allowing a diverse set of actors to voice their expectations around landscape challenges, regime ability to respond, and promise of niches to provide solutions. Requires accepting and making explicit tensions and conflicts of interest among expectations.</p> <p>For example, by organising futuring processes that articulates a wider range of expectations about the future of water management in a specific region addressing conflicting demands by farmers, ship owners, consumers and nature conservation and allows for deliberating these futures.</p> <p><i>Deepening</i>: developing credible expectations by aligning landscape, regime and niche expectations of both niche and regime actors and supporting this alignment with concrete evidence.</p> <p>For example, by organizing a transition arena in which actors have to come up with a shared vision and proposal for a set of experiments for new water management practices they will collectively develop and fund.</p> |
| 2. Expanding and mainstreaming niches | 2.1 Upscaling | <p>Increasing adoption by users of the new emerging system, this is not only about adoption of a new set of user preferences and technologies but also wider adoption of policy measures, industry strategies, and cultural meanings and symbols.</p> <p>For example, by setting up a user club that organizes an internet platform about the use of heat pumps, or a communication and marketing campaign for use of fuel cells in townships in South Africa advocating decentralized energy provision without access to the grid.</p> |
| | 2.2. Replicating | <p>Intentionally facilitating the replication of specific niche experiments in other contexts.</p> <p>For example, by creating a funding program, or any other mechanism (intermediary actor, education and capability building program) for</p> |

| | | |
|------------------------------------|---|--|
| | | replicating an experiment with local and direct food provisions from one city to many cities. |
| | 2.3 Circulating | <p>Identifying and promoting circulation of ideas, people, blueprints, technologies between niches on a more continuous basis.</p> <p>For example, creating an intermediary actor responsible for the circulation among a wide range of experiments for retrofitting houses in a specific country, or larger region. This action could include organizing training to exchange ideas, mutual visits, and promotion activities.</p> |
| | 2.4 Institutionalising | <p>Mainstreaming the rules of the niche (behaviour, beliefs and values) among existing and new niche actors. This is a process of creating a stable market niche or even a new regime.</p> <p>For example, creating a handbook, a certification scheme and a set of standards for how to fish salmon in a sustainable way.</p> |
| 3 Opening up and unlocking regimes | 3.1 De-aligning and destabilising | <p>Facilitating the development of disruptive policy frameworks and governance arrangements (such as organisational and administrative reforms) that challenge existing systems.</p> <p>For example, developing a phasing out policy for coal burning plants, mobilising social protests, or going to court to challenge non-compliance with internationally agreed targets on reducing CO₂ emissions.</p> |
| | 3.2 Unlearning and deep learning in regimes | <p>Facilitating unlearning and deep learning among regime actors, helping them re-assess the regime rules in comparison to new alternative rules for solving systemic problems.</p> <p>Example organizing a policy lab to discuss a wide range of policy barriers for using insects as a food product in the Netherlands, or a policy lab to discuss the barriers for procurement of sustainable food by schools or hotels.</p> |
| | 3.3 Strengthening regime-niche interactions | <p>Creating linkages (formal and informal) between niche and regime actors, and their ideas and resources with the aim to empower niches and make them more competitive.</p> <p>For example, developing a new impact investments tool that will crowd in investment into niche activities by traditional banks and investors and crowd-out investment in unsustainable technologies and systems.</p> |
| | 3.4 Changing perceptions of landscape pressures | Facilitating processes to challenge individual and collective perceptions about landscape pressures of diverse groups of regime actors - policy makers, producers, businesses. |

| | | |
|--|--|---|
| | | For example, by organizing specific foresight activities with regime actors about the question whether and how digitalisation could contribute to climate action. |
|--|--|---|

4. Case studies

We present two cases of currently ongoing transformative change in which experimental policy engagements played a role. First, we discuss Mobility-as-a-Service in Finland. After that follows the case of Speciality coffee production in Colombia. In each case, we seek to make visible the emergence of transformative outcomes.

4.1 Transition towards intelligent transport systems and mobility-as-a-service in Finland

Mobility-as-a-service (MaaS) has since 2014 developed as a niche in Finland, with support from a mix of regime and niche actors. They have perceived a need to move from individual ownership of cars to personalised mobility services to reduce the environmental impacts of transport, and improving access for people who cannot afford to own a car. The concept of MaaS, proposed by a championing niche actor in 2013, focuses on optimising the connection between private vehicles and public transport via shared mobility services. In Finland, MaaS is typically defined by the key niche actors as specific ‘packaged offerings’ with intermodal planning, booking and payment components, comprising multiple transport modes. As such, the MaaS niche challenges the dominant transport regime that is built around individual motorised transport.

The engagement of policymakers on MaaS dates back to how communications and transport policy began to be renewed from the mid-1990s, influenced by Nokia developing into a major global telecommunications company and in response to landscape developments related to digitalisation, urbanisation, ageing population and climate change. This process led to specific interest in intelligent transport systems. In 2004, the Ministry of Transport and Communications encouraged the establishment of a collaboration network, Intelligent Transport Systems Finland (ITS Finland). The network was set-up as an association, including civil servants, companies and researchers advancing intelligent transport. The director and chairman of ITS Finland developed the MaaS concept in discussion with members. This is the start of the niche building process (*TO3 Networking*: still quite limited, likely not broad or deep enough; *TO4 Expectation dynamics*; actors voicing expectations about the future potential of ITS, not necessarily broad or deep).

During 2007-2011, transport policy underwent new developments, including two strategies for intelligent transport and organisational changes leading to multi-modal agencies. In 2012, the Minister for Transport established the New Transport Policy Club, an experimental arena for years 2012-2014 to renew transport policy and address the challenges of climate change, automation and servitisation. It aimed at generating deep learning across sectors, extending beyond the public sector, leading to the beginnings of opening up and unlocking of the mobility and communication regimes (*TO10 Unlearning*, policy actors began to question their beliefs about the future of mobility and role of communication; *TO12 Changing perception of landscape pressures*, combining the need to combat climate change with new digital opportunities). In one of the meetings, the Director of ITS Finland introduced the idea of MaaS drawing from thinking in the telecommunications sector. This roused the interest of a regime actor, a high-level civil servant and many others, who began advancing the idea. A group of actors, including ITS Finland, a niche actor, and the City

of Helsinki and the Ministry, regime actors, began creating a vision for MaaS. This is a next step in the niche building process, building on regime actors working with niche actors. Since this step consists of a limited set of interactions we call the processes limited (*TO4: limited Deepening Expectation Dynamics; TO3: limited Broadening and Deepening of the Networking; TO11: beginnings of Strengthening Regime-Niche interactions*). As a result, in 2014, the Ministry launched a proposal on MaaS.

In 2014, the ministry established a Traffic Lab which operated as an umbrella for public-private experimentation around intelligent transport systems and as a space for learning about technical solutions and how to change people's mobility assumptions, preferences and practices. It aimed nurturing the niche developments (mainly through *TO2: Broadening and Deepening of Learning*). It was coordinated by the transport administration but included other public actors, such as the Finnish innovation funding agency Tekes. MaaS was one of the themes explored.

Initially, in 2014 in Tekes, MaaS was a small, informal initiative; a campaign to activate new companies to begin developing new technologies and services. A joint campaign of Tekes and the Ministry of Transport organised round tables on themes linked to MaaS, inviting companies to discuss the vision for MaaS, needs of municipalities, public transport providers, designers to think about service design, and some focused on logistics (this led to *TO4: further broadening and deepening of Expectation Dynamics*). Some niche actors viewed Tekes even as a thought leader who made sure MaaS advanced. In 2015, Tekes established a MaaS programme. It included a two-stage call to fund MaaS operators. The first stage funded several pre-studies that plan real MaaS pilots and co-design them with potential partners. The second stage funded more concrete test beds where the projects included good collaborators and external investors. MaaS businesses regarded this funding programme instrumental, while some Tekes officials called it experimental, being initiated bottom-up and by-passing the usual bureaucratic process of programme-setting in the organisation. Effectively this contributed to broadening and deepening of all niche building outcomes (*TO1-TO4*) and was succeeded by a network among multiple companies (including large companies in the telecoms sector, Helsinki Regional Transport and the taxi union) that explored what an actual MaaS operator would look like (*TO2: Broad and Deep Learning; TO3: Deep Networking*). The end result was the development of a niche. After the MaaS programme ended, funding for MaaS-related projects was integrated into Tekes's ongoing Smart City Programme (2014-2017). This was the start of a process of expanding and mainstreaming the MaaS niche, but also *de-stabilising the regime*, mainly its science, technology and innovation dimension (*TO9*).

From 2016, different companies began operating with MaaS pilots. A new start-up, MaaS Global, began pilots in Helsinki, Antwerp and Birmingham (*TO5: Replication*). An incumbent telecommunications company, Telia launched a MaaS app in the Häme region combining national rail services and local taxi services (*TO2: further broadening of Learning*). In 2016, the European MaaS Alliance was also created, aiming for the creation of a 'global' niche, and consolidation of niche efforts at the European level (*TO8: beginnings of Institutionalising the niche*). The founding members included regime actors, such as the Finnish Ministry of Transport and Siemens, and niche actors, such as MaaS Global and the ITS Europe network.

During 2016-2019, the public transport administration went through two stages of organisational changes, first, the full integration of transport and communications in the Ministry and later its agencies (*TO9: Destabilisation of the policy dimension of the regime*). These created opportunities for new interaction and learning for the civil servants.

The policy renewal process together with MaaS development led to a major regulatory renewal, called the Transport Service Act in 2017. It required public transport providers to open data and electronic access to timetables, prices and ticket sales, allowing third parties to sell transport tickets – effectively removing barriers for the running of MaaS operators (*TO8: further Institutionalisation*). It also deregulated taxi transport, so that multiple operators were allowed in the same area (previously prohibited). Many actors described it as ground-breaking and unique transport sector legislation globally, disrupting the regulatory-side of the transport regime (*TO9: further Destabilisation of regime policy dimension*).

In some Finnish cities, public transport operators have been unwelcoming for MaaS providers to appear on their “turf”. They have been reluctant to allow third-party ticket sales of all types of tickets, hindering the upscaling of MaaS. Taxi providers have opposed change, where multiple companies can provide taxi services in a given area, increasing competition. The enforcement of the Transport Service Act has been strengthened by threats of penalty payments issued by the Transport and Communications agency, but the underlying tensions have not yet been solved.

In 2018, Business Finland (previously Tekes) awarded subordinated loans as part of its new Growth Motor Funding, an experimental policy for funding networks of companies, in total 28.4 million euros to five different companies, two related to MaaS. This provided further shielding (*TO1*) and deepened networking (*TO3*), while also supporting efforts in niche expansion (*TO5 Upscaling, TO6 Replication*).

4.2 Colombia speciality coffee case

This case will study the emergence of speciality coffee as a niche in Colombia. The coffee industry is one of the most important export sectors in Colombia, providing a living for close to 800,000 people. The emergence of the specialty coffee niche followed a break-down of the established international system of supply and prices of production of coffee as a commodity. Until the 1990s, the Colombian coffee sector was firmly wedded to a commodity model of production – farmers receive a set price for a standardised quality of coffee bean which is mainly used for exports - smaller and off-colour beans were sold for domestic consumption. This hitherto stable system was thrown into disarray in the 1990s with the breakup of the International Coffee Organization (and the associated International Coffee Agreement). New entrants to the market, such as Vietnam, the mechanisation of production in Brazil, and the problems of ageing coffee plants in Colombia resulted in the collapse in commodity coffee prices. Speciality coffee therefore emerged as a niche to the commodity model by international organisations such as Fairtrade and the Rainforest Alliance. This represents an alternative international system of certification for production of coffee. Its transformative feature is that it has a vision of coffee that is in harmony with the environment and has a strong commitment to local social development.

However, in the years preceding the crisis, research by the incumbent actor in Colombia, (the National Federation of Coffee producers (FNC) into alternatives to the commodity model, remained marginal and the highly centralised FNC did not undertake serious investment into viable alternatives. Consequently, the Colombian coffee system remained locked into a commodity model of production (Echevarria et al 2014:5). Pressure on the FNC to scale up the search for alternatives to the existing system emerged both from the collapse of international coffee prices as described above, but also following an explosion of social movements and protests of more than 100,000 farmers with small lands in the late 1990s. These took place in ten of the country's regional departments with marches and blockage of principal roads. The protests sent a clear message that the system was misaligned (Cruz-Rodriguez 2013: 145) and speeded up

the search and implementation of changes to the existing policy and governance arrangements, thus opening up and unlocking of the national coffee regime (TO12: Changing perceptions of landscape pressures; TO9: Destabilisation of the regime). This process was reinforced by the fact that niche actors in other countries had been experimenting successfully with alternative sustainable visions of coffee value chains. The first Rainforest Alliance farm was certified in Guatemala in 1995 and by the year 2000 the specialty coffee market had grown to \$8bn (SCAA website). This market was an important passive shielding for small farmers (TO1: substantial passive shielding was put in place due to landscape changes, out of control for Colombian coffee farmers) who in the next years would adopt speciality coffee as an alternative to the commodity model of production

This adoption process became a search process for building and nurturing the speciality coffee niche. In this process, existing farmers experienced deep learning at the individual and collective level (TO2: Substantial deep learning). Under the commodity system, the farmer was largely disengaged and alienated from his/her produce. There was little opportunity to improve the quality of the product and few incentives to improve environmental practices. With specialty coffee, producers moved from “producing a coffee bean to producing a drink”. Farmers learnt to become tasters and developed knowledge about different preparation methods (e.g. espresso-based drinks). They also developed skills around coffee washing, fermenting and drying and to follow certifications that demand careful implementation of practices that do not harm the local environment.

For small farmers the deep learning was critical in helping to reset expectations concerning their role in coffee production. The emerging expectation was speciality coffee would prioritise small-scale producers and help articulate the importance of greater access by smallholders to training, education, finance and access to market trade shows. This would trigger a sense of belonging of small producers with their sector that would engender a greater stake in the future of the sector, which then would lead to greater stewardship of the land and education of the children in the new methods of the industry. Thus, new expectations were expressed for regime development (inability of dominant practice to come up with a solution) and the potential of the specialty coffee niche were knit together, which initiated a self-fulfilling prophecy (TO4: Substantial broadening and deepening of expectation dynamics).

At the collective level, farmers were incentivised to organise themselves into cooperatives that are crucial to integrate knowledge and build trust. These cooperatives built new networks with intermediaries, consumers and other farmers (TO4: substantial Broad and Deep Networking). These processes prompted new collective voices to express more disruptive notions of coffee value chains (TO4 reinforcing the expectations dynamics). These include re-imagining coffee chains where farmer knowledge and farmer need in the coffee value chain are legitimised. Value chains are re-thought, where farmers have a major say in defining criteria of certifications (leading to experimentation whereby farmers can choose who buys their coffee). In the search process the actors worked on all transformative outcomes calling the specialty coffee niche into being. Although these more disruptive conceptualisations of the value chain have yet to emerge in practice to any large extent, the experiences highlight the fact that transition processes can open up multiple pathways of change with varied alternatives.

The niche expanded and was mainstreamed through the adoption of certifications - the Utz Kapeh certification in 2002, the Nestle’s AAA Sustainable Quality Programme with the Rainforest alliance (Nestle website) in 2003 and the participative agricultural innovation farms certification in 2014 - that helped develop new regional varieties (TO9: Institutionalizing the niche). In the meantime, in 2004 the first

smallholder coffee farmer association was established in Huila with the support of the FNC. This was a result of a process of actively circulating and replicating knowledge from different experiments (TO 6: Replicating; TO7: Circulating), leading to substantial upscaling (TO4). Colombia's speciality coffee production grew from 2 percent of the total coffee exports in 2000 to 28 percent in 2013 (Echevarria et al 2014). In 2014 Huila reported a total of 101,000 coffee farms producing 17.4 percent of the Colombian coffee harvest passing the 16 percent threshold for niche acceleration adoption (FNC 2014)

This success was not only a result of the work of niche actors, since, as discussed above the main regime actor in the Colombian coffee sector, the FNC, eventually also scaled up work on speciality coffee (TO11: Strengthening regime-niche interactions). In 2002, the FNC created Procafecol and Juan Valdes coffee, providing a boost to speciality coffees (TO8 Institutionalising the niche). The coffee sector therefore increasingly changed and became a more diverse value chain with NGOs, specialised growers (for example women's groups) and buyers establishing their own local distribution chains and also working with the FNC. In 2006 the FNC established the "Women's Coffee programme" by means of an integral programme of gender equality to support empowerment of women in all areas related to coffee production, participation in the FNC and community leadership (2015 FNC report). FNC created new extension agents that were crucial in actively phasing out (unlearn) unsustainable practices such as non-sustainable discard of coffee shells. Previous practices were re-assessed and new production techniques that are sustainable with the environment were introduced (TO 10: Unlearning and deep learning in regimes).

5. Discussion

5.1. Comparing our two cases

In this section, we discuss the refinements to our approach that emerged from engaging with these case studies, namely our (theoretically-derived) definition of the transformative outcomes. We do not seek to provide a definitive appraisal of the cases in question and the extent of their transformation. Even with stylised cases, the salience of the transformative outcomes we identified is clearly visible.

For both cases, we sometimes made assessment of the quality of the transformative outcomes, for example, by saying it was substantial. When applied in real-time EPEs, these quality assessments should be done together with the actors in a formative evaluation process. In that process, the focus is on using a discussion about outcomes to reflect and induce learning among actors on how to improve (Molas-Gallart et al., 2020).

The MaaS case shows that many TOs are worked upon by the actors, leading to a robust process of niche development on all four outcomes: shielding, learning, networking and expectation dynamics. Robust means that all processes were of sufficient quality to lead to a niche that is clearly recognisable as such by all actors. This process of niche building was enabled by a process of regime opening and unlocking, mainly by transport and innovation policy dimensions at the national level. However, this process has not extended significantly to city-level policy-making in Finland. The case is characterised by early and active participation by national regime actors, in particular the national innovation agency (Tekes, subsequently Business Finland) and the Ministry of Transport and Communications. These actors had several EPEs expressed in the development of the New Transport Policy Club, the Traffic Lab and Tekes's MaaS Programme. The development intertwined with major organisational changes in the administration for transport and communications and led to a major regulatory change in the transport sector. These

changes began to destabilise the operational context for many transport sector actors and removed barriers for niche expansion. However, while the policy changes aimed to influence many regime dimensions, changes in the other regime dimensions, especially in the preferences of mobility users, and the mobility culture have not yet substantially changed. Most niche expansion outcomes were also insufficiently covered.

The MaaS case illustrates how development in multiple TO's can happen in parallel and is not in a linear, sequential process. Taking 2014 as the starting point, we observed six years with many actions happening in parallel. The process was initiated in dialogue between niche and regime actors, who searched for new opportunities in response to intensifying landscape pressures on climate change, digitalisation and automation, and economic developments. Gradually a more transformative path developed fuelled by expectation and network dynamics. Actors working from within the dominant regime managed to carve out a niche for a radical substitute for the dominant mobility regime, challenging the clear separation between public and private transport provision and individual car ownership.

In terms of innovation policy, STI policy actors were rather early on involved in the process of creating the MaaS niche, and they were central to various EPEs - including one set-up by Tekes. Yet, within the overall STI policy in Finland, this has been a marginal activity. A deeper change of STI policy orientation towards transformative change has not yet taken place. This is different from the transport and communications policy that has adopted an experimental approach responding to societal challenges and opportunities.

The Colombia specialty coffee case shows all TOs leading to robust niche building: shielding, network, learning, expectation dynamics and networking. The shielding, however, was not provided by national or local policy-making, but by influential niche actors working at different multi-scalar levels (production, consumption, logistics) to develop an alternative sustainable vision of the value chain that is capable of integrating local producers at the grassroots level. The subsequent learning was deep, because many assumptions about coffee production were challenged and expectations were opened for new futures, questioning a business-as-usual response. Farmers changed their behaviour, beliefs and values during the process. For the farmer, in many ways the journey followed a 'stretch-and-transform' pattern.

The existing regime was clearly no longer fit for purpose and regime actors were willing to reorient their beliefs and behaviours following a shock fall in prices. New national and international networks emerged among farmers and supporting institutions. The process of niche building and nurturing led to a process of niche expansion moving beyond the 16 percent threshold for niche acceleration. Farmers circulated their ideas and experiences, building new platforms. They replicated experiments that could be institutionalised through international certification schemes. Although the traditional coffee regime opened up for change, many farmers had to unlearn existing practices and change their perception of landscape developments. While regime actors invested in the specialty niche, this niche did not replace the dominant regime. Currently, after 15-20 years of development, specialty and commodity coffee coexist, the latter serving other markets. The case is characterised by bottom up actions by farmers, while it lacks policy involvement and engagement with STI policy actors.

5.2 Lessons for transformative innovation policy

Both cases deliver some clear lessons for transformative innovation policy and the use of transformative outcomes. We below summarise these lessons in five points.

First, the cases confirm our proposed starting point on transformative innovation policy: transformation is ongoing, also in cases where innovation policy-making is absent or connects only later to the transformation process. Innovation policy and STI actors should actively engage with such ongoing transformation processes, and innovation policy should be designed, implemented and evaluated from this perspective (cf. Kuhlmann and Rip, 2018). The transformative outcomes, proposed here, can help to make such policies more transformative.

Second, transformative outcomes place explicit attention on (i.e. make visible) the processes required by transformation, and enable STI actors to actively work with transformation. Missing outcomes can be identified and addressed. When transformative outcomes are used in designing, implementing and evaluating STI projects, programmes and policies, we expect actors to deliberate which outcomes they want to prioritise and in which stage. This is a reflexive process which requires actors to collectively reflect on their own actions as well as possible and desired consequences (cf. Weber and Rohrer, 2012). In this process, STI actors need to realise that these outcomes do not result from one or two policy interventions. As our case-studies clearly show, they emerge from a complex set of actions unfolding over longer time periods. Yet they may help STI policy actors to stay focused on a systematic approach, building on an understanding that they may have to coordinate with other policy actors to realise all desired outcomes. This coordination may be partial and selective, but overall coordination is elusive anyway and may also lead to a fit-and conform pattern.

Third, the engagement with outcomes is not only about having specific outcomes developing but also about stretching them. For example, learning may be deep, but perhaps it can be made even deeper. Or networks can be broadened by making them more inclusive. To assess whether and how this is true, STI agents should engage in a reflexive deliberation process with all actors improving the quality of the outcomes.

Fourth, the transformative outcomes proposed here emphasise the importance of adding mechanisms to innovation policy that address the opening up and unlocking of socio-technical regimes. This resonates with earlier propositions for innovation policy to consider also destabilising or disruptive effects alongside niche building and expansion (Kivimaa and Kern, 2016). Both cases provide insights into the relationship between regime destabilisation and experimentation. For example, in the MaaS case the Ministry for Transport and Communications developed into an STI actor also engaging with the outcomes associated with regime unlocking. The specific circumstances in which regime destabilisation happens is, however, highly unpredictable, unforeseen and often triggered by endogenous or exogenous crises that escape the authority of any actor in the system. Yet, the willingness of STI policy makers to engage in those circumstances by framing changes as windows of opportunity and using them to create policies for regime openings is important.

Fifth and finally, the ways in which transformative outcomes can be achieved are highly context specific. Both cases we presented here are heavily embedded in their local, regional and national socio-economic and political settings. For instance, in the context of Colombia, shielding was provided by the agency of local coffee producers who were included in a global value chain and were acting across multiple scales (local, national and global). In contrast, experimentation with MaaS was a national policy-led process that fitted the policy agenda, which had emerged in Finland after the future of Nokia had deteriorated. Finland needed to look for other use of its ICT capabilities.

6. Conclusion

In the face of persistent social and ecological challenges, new approaches to science, technology and innovation policy are necessary. Globally, STI and other agents of change are already experimenting with challenge-led innovation policies, which are ambitious in achieving SDGs, yet lack appropriate implementation and evaluation processes in order to mitigate the issues of coordination, lack of reflexivity and inclusion. The transformative innovation policy lens offers a critical entry point for guiding the operations of STI and other change agents towards more transformative results.

Sustainability transitions literature, on which the theorisation of TIP is based, offers a wealth of knowledge about systemic transformation and transition dynamics. This knowledge is however often dispersed and inaccessible to policy practitioners. The framework of twelve transformative outcomes, introduced in this paper, operationalises key insights from that literature to guide the practices of STI agents working towards enabling transformations. The outcomes are categorised across three spatially bounded macro processes that can facilitate transformations: 1) building and nurturing niches, 2) expanding and mainstreaming niches and 3) opening up and unlocking regimes. Within the process of building and nurturing niches, shielding, learning, networking, and navigating expectations are the transformative outcomes. For expanding and mainstreaming niches, upscaling, replicating, circulating and institutionalising are fifth to eighth transformative outcomes. The final four transformative outcomes within the regime level transformative process are de-aligning and destabilising, unlearning and deep learning, strengthening regime-niche interactions and changing perceptions of landscape pressures.

These outcomes can be achieved through experimental policy engagements (EPEs) that foster continuous monitoring, evaluation and reflexivity in the conduct of actors for transformative change. In this way, transformative outcomes should be used as a reflexive action framework, rather than a prescriptive step by step guide of how to achieve transformations.

The application of the transformative outcomes framework to reinterpret two case studies - mobility-as-a-service in Finland and specialty coffee in Colombia - confirmed that, in order to transform systems, STI agencies need to attend to opening up for more radical transformations 'within' the regimes, instead of just initiating new niche projects and hoping they would scale. Our results suggest that these activities are also experimental and require specific provisions not easily attainable through conventional policy. This is a significant departure from both traditional transitions theories and innovation policy assumptions that experiments are primarily relevant for novelty creation in building niches. Here, we advocate for an explicit experimental culture that recognises and engages the various societal experiments within and beyond government, and which leverages specific forms of evaluation to make the outcomes of policy practises to be more transformative.

Practically, which sub-set of transformative outcomes to prioritise with a given policy engagement depends on the status of the unfolding transformations. Given their complexity, we assume that it may be impossible to 'assess' this status objectively ex-ante. TOs, therefore, serve as a process-oriented heuristic with which to interrogate transformation processes through the co-creation process of TIPC in order to support and improve the transformational efforts of current and future TIPC members. In future research and policy actions, it would be important to identify and test which transformative outcomes are relevant in a particular system and in particular context, how to improve the quality of the outcomes and how to stretch existing actions to achieve more transformative outcomes.

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